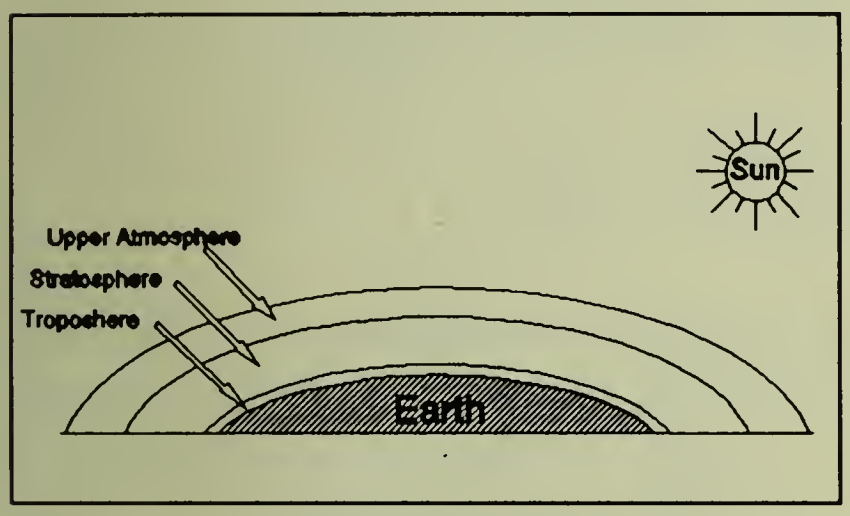
Mass Reduction

OZONE DEPLETION, ULTRAVIOLET RADIATION AND YOU

What is the Ozone layer?

The ozone layer shields the earth from the harmful ultraviolet radiation of the sun. Twenty-five kilometers above the earth's surface, in the stratosphere, the ozone layer filters out these harmful rays. Ozone, an unstable molecule, is comprised of triplets of oxygen atoms. At its highest concentrations, ozone is present in only a few parts per million. *One part per million is roughly equivalent to a half cup of water in a 30,000 gallon railway tankcar.* The protective ozone shield is currently threatened by a few manmade chemicals.



What is happening to the ozone layer?

Chemicals containing chlorine and bromine, released from industrial processes and consumer products, are causing the disintegration of the ozone layer. The majority of the chlorine comes from chloroflourocarbons (CFCs), while bromine originates from halons used in fire extinguishers. Most CFCs have several chlorine molecules which easily detach. The chlorine's strong affinity for single oxygen molecules splits the ozone molecules apart. This forms chlorine monoxide, which is unstable and soon breaks apart. The chlorine then seeks other oxygen molecules to join. This chain reaction can continue for the life of the CFC molecule, sometimes as long as 100 years. Table 1 gives the atmospheric lifetimes of these ozone depleting compounds (ODCs), which directly corresponds to the length of time a molecule can destroy ozone.[1]

How does a depleted Ozone layer affect us?

As the ozone layer is progressively depleted, its ability to screen out ultraviolet radiation will be greatly reduced. UV-B, the most dangerous of the ultraviolet spectrum, has many detrimental effects on humans, animals and plants:

- UV-B rays can cause skin cancer and cataracts. Each 1% drop in Ozone is expected to result in an increase of 4-6% in skin cancer cases.[2]

- UV-B also depresses the human immune system, lowering resistance to infections and tumors.

- UV-B radiation decreases the photosynthesis, water-use efficiency, and yield of crops. Soybeans exposed to a simulated 25% reduction in ozone had a reduced yield of 25%. In addition, plant vulnerability to UV-B increases as the phosphorus level in the soil increases. This indicates that heavily fertilized agricultural areas may be the most vulnerable.[3]

- Phytoplankton, food source for fish larvae, live in the oceans' surface waters and are susceptible to ultraviolet light. Studies show that a 25% reduction in ozone would decrease their productivity by about 35%. Commercial fish populations already threatened by over-harvesting may have more difficulty rebuilding in an environment with increased UV-B.[4]

- Increased UV-B levels also affect synthetic materials. The EPA estimates that the breakdown of one susceptible plastic, polyvinyl chloride, could cost the U.S. $4.7 billion by 2075.[5]

How are Global Warming and Ozone Depletion connected?

CFCs and halons contribute to the greenhouse effect by absorbing heat from the earth that would normally escape to outer space. Other gases, such as Carbon Dioxide and Methane, also contribute to global warming; but one molecule of CFC-12 is equivalent to 15,000 molecules of carbon dioxide. Heat absorption by CFCs is projected to account for 15 to 20 percent of the expected warming.[6]

What is being done?

In August, 1987, 27 countries met in Montreal, Canada and signed the Montreal Protocol. The agreement limits the production and sale of CFCs and other ozone-depleting chemicals, and calls for an eventual phase-out by the year 2000. A hypothetical plan for CFC phaseout in the United States would consist of three phases:

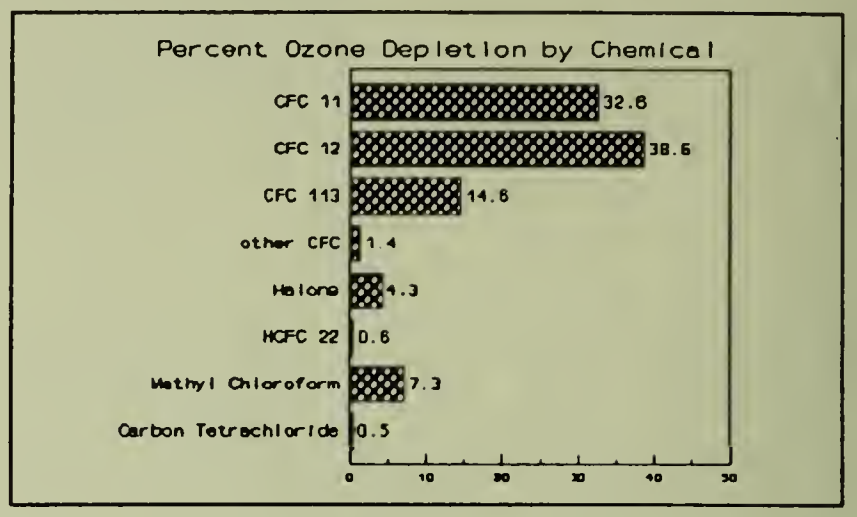
- CFC-12 would be heavily taxed to encourage conservation through recovery, recycling, and more efficient systems.

- The government would fund research to develop substitute chemicals that do not degrade the ozone layer. DuPont already has what it feels are the environmentally benign substitutes, HCFCs; however, the company says it is unable to market them due to a lack of consumer demand.[7]

- Education efforts would be used to raise awareness worldwide and counter current apathy toward ozone damaging products.

Will the Montreal Protocol be Enough?

Unfortunately, no. Many inducements and incentives were offered to entice countries to sign the protocol. The effect of these loopholes greatly compromises the Protocol's strength, and will not meet the goal of halving worldwide CFC use by 1998.[8] Scientific findings have revealed more ozone depletion than the treaty negotiators assumed would happen in 100 years. A recent EPA report concluded that with 100% global cooperation, chlorine concentrations in the atmosphere will still triple by 2075. The agreement will not stop the depletion of ozone--only slow its acceleration.[9]



How significant is the consumer contribution?

Recycling programs for existing CFCs and research into possible substitutes are short term solutions. Consumers must be made aware that their purchases and lifestyles have influenced industry to develop and manufacture chemicals such as CFCs. Consumers must now evaluate the choices they make when purchasing, and be conscious of their influence. Consider these facts:

- Total annual per capita use of the three most common CFCs is highest in the United States, at 1.22 kilograms. Europe and Japan are not far behind, with .93 and .91 kilograms respectively.[10] Table 1 shows the relative amounts of CFCs and HCFCs that were emitted in 1985.

- The foam walls of modern household refrigerators contain five times the CFCs used to run the compressor.[11] Current recycling programs only deal with the refrigerant in the compressor. This helps, but five times that amount is released when the refrigerator is shredded for disposal.

- Eighty percent of the automobiles sold in the United States are equipped with air conditioning systems. These Mobile Air Conditioning units (MACs) account for 92% of the 144 million kilograms of annual CFC -12 leakage from air conditioners.

- Three-fourths of the food eaten in the United States is refrigerated at some point in the production and distribution chain.[12]

What are the alternatives?

For many years people lived in relative comfort without air conditioning. It is not necessary to ban the use of air conditioners but preventive alternatives must be developed. Appropriate construction materials, natural shade, and local weather and wind patterns can naturally cool and heat a house. Tighter windows, insulation and efficient lighting can also reduce heat generation in a building -- thus reducing cooling needs.

There are several encouraging signs on the horizon. A supermarket in Glens Falls, New York has replaced all of its CFC-driven refrigerators with alternative, HCFC 134a-driven models. HCFC 134a is made by DuPont.[13]

Scientists at Los Alamos National Laboratory in New Mexico have been developing a device that uses sound waves to cool air. This could have applications for replacing CFC compressors in refrigerators.[14]

Scientists at The National Renewable Energy Laboratory have been developing vacuum insulation. One inch of material has the equivalency of 27 inches of fiberglass insulation. This might make an ideal replacement for insulation in refrigerators, where thickness is a key constraint.

According to the EPA the high tech industry accounts for about 10% of CFC releases during the cleaning of printed circuit boards and chips. Digital Equipment Corporation, an electronics manufacturer, was recently awarded for developing a CFC-free cleaning technology. The washer, conceptually similar to a dishwasher, cleans parts with hot water and a softening detergent instead of soaking them in CFCs.[15]

DuPont has created chemical substitutes for CFCs that will do very little or no damage to the ozone layer. The chemicals are more expensive than CFCs, but the firm feels they are worth it.

Table 1: Profiles of Commonly Used Chemicals, 1985

Chemical	Releases (kilograms)	Atmospheric lifetime (years)[1]	Applications	Ozone Depletion Potential[3]	% Depletion Contribution
CFC-12	373,766,400	139	A/C, Refrigeration, Aerosols, Foams	1.0	45
CFC-11	215,913,600	76	Foams, Aerosols, Refrigeration	1.0	26
CFC-113	125,193,600	92	Solvents	.8	12
Carbon Tetrachloride	59,875,200	67	Solvents	1.1	8
Methyl Chloroform (111-trichloroethane)	430,012,800	8	Solvents	.11	5
Halon 1301	2,721,600	101	Fire Extinguishers	10.0	4
Halon 1211	2,721,600	12	Fire Extinguishers	3.0	1
HCFC-22	65,318,400	22	A/C, Refrig., Foams	.05	0[2]

1. Time required for a 63% reduction of the chemical in the atmosphere
2. Contribution of HCFC-22 rounds off to zero
3. Comparing the other chemicals relative to CFC-11 (base value of 1.0)

Sources: James K. Hammitt et al., "Future Emission Scenarios for Chemicals that May Deplete Stratospheric Ozone," *Nature*, December 24, 1987; U.S. Environmental Protection Agency, *Regulatory Impact Analysis: Protection of Stratospheric Ozone*, Volume II Part 1 (Washington D.C.; 1987); Douglas Cogan, *Stones in a Glass House: CFC's and Ozone Depletion* (Washington D.C.: Investor Responsibility Research Center, 1988). World Watch Paper #87, *Protecting Life on Earth: Steps to Save the Ozone Layer* by Cynthia Pollock Shea, Dec 1988, p.27; Reduction of CFC Emissions from Motor Vehicles, Calif. Air Resources Board, July 25, 1990.

TABLE 2: Quantities of Leakage from Consumer Products

Source of Leak	Type	Type of CFC	Charge	% Leak	No. of Items	Total Leak (Kg/yr)
Mobile AC Systems	US Cars	CFC-12	1.21 Kg	7.4 %	83,969,900	101,603,600
	Imports	CFC-12	0.88 Kg	7.4 %	31,987,100	31,668,600
Hshld Refrig.[1]	Refrig.	CFC-12	0.33 Kg	0.2 %	159,214,500	10,508,100
Residential Light AC	Window	HCFC-22	1.5 Kg	21 %	26,547,000	8,362,305
	Unitary	HCFC-22	2.9 Kg	21 %	33,006,000	20,100,654
TOTAL		CFC-12				143,780,400
TOTAL		HCFC-22[3]				28,463,000
Industrial Cont.	Cleaning[2]	CFC 113[2]				62,361,000

[1] Refrigerator insulation, typically foamboard, is CFC blown and contains 1.55 kgs of CFC-11.

[2] Industrial Contribution for 1989, from the EPA TRI reporting database. Represents only companies who are required to file. CFC 113 is the only reportable CFC, others are used but do not have to be reported.

[3] HCFC-22 Total represents only quantities used in residential air conditioning.

Source: ICF Incorporated "Charge Sizes and Leakage rates for Vintage Model Equipment Stocks"; Total Equipment Stocks, estimated 1992.

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4. "What are the Effects of UV-B Radiation on Marine Organisms?" Testimony of Robert C. Worrest in Germany. April 27,1988

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7. Conversation with Bill Shrewsbury of The Simons Company, 3-17-1992

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11. Cogan, *Stones in a Glass House*

12. Michael Weisskopf, "CFCs: Rise and Fall of Chemical 'Miracle'", *Washington Post*, April 10, 1988. EPA, addenda to *Regulatory Impact Analysis; The Montreal Protocol: A Briefing Book* (Rosslyn, Virginia: Alliance for Responsible CFC Policy, 1987).

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14. "Cooling with Sound: An effort to Save the Ozone Shield" Malcolm W. Browne, *The New York Times*, February 24, 1992 page C1

15. *Industry*, May 1991 "Digital Lauded for Pro Bono Work". p24. Contact at Digital about this technology (207) 626-3939

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World Watch Paper #87 by Cynthia Pollock Shea
The CFC Problem- An Overview by Robinair Corporation
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